Transportation Modeling Tools

Rainer Dronzek

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TranSystems

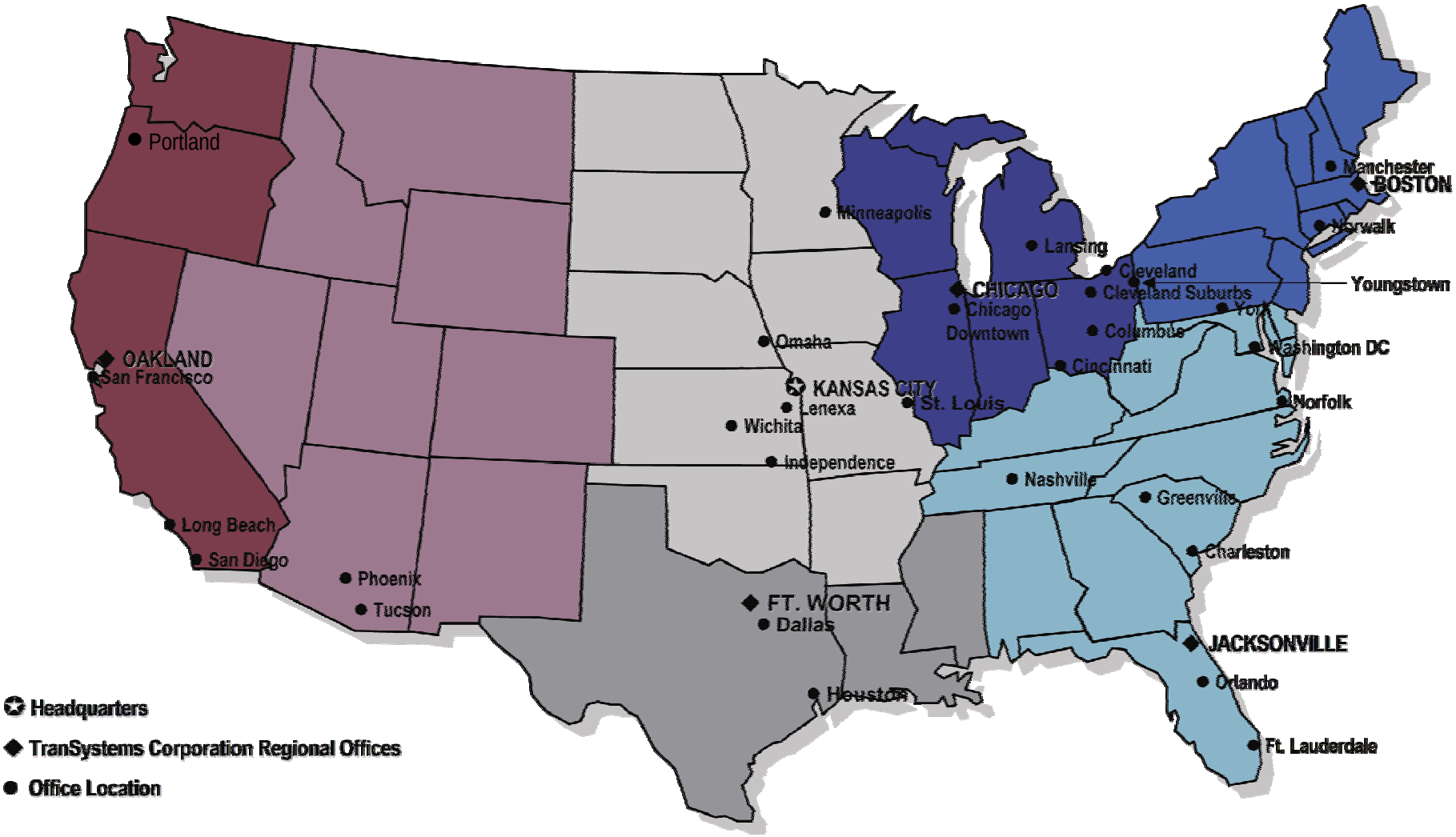
Presenter Info

- BSEE, Bradley University
- Institute of Industrial Engineers simulation “Ask the Expert”
- Simulation Solutions Conference chair and track coordinator
- Transportation experience
  - Transporting oil to the surface – Schlumberger
  - Transporting humans to space – Space Shuttle program
  - Transporting military and commercial payloads – McDonnell Douglas
  - Developing transportation-related models - TranSystems

TranSystems

- Headquartered in Kansas City, 36 U.S. offices
- Over 1,000 professionals plan, design, build, and manage commercial and government infrastructure
- Lines of Business
  - Architectural & Engineering
    - Planning
    - Civil and structural engineering
    - Architecture
    - Construction management
  - Management & Supply Chain Consulting
  - Security
  - Real Estate

TranSystems Office Locations



TranSystems Core Markets

Freight Rail Carriers

Passenger Rail & Transit

States & Municipalities

Airports & Air Carriers

Shippers & Distributors

Ports & Maritime Carriers

Trucking & Automotive Companies

Energy & Communication Carriers

Federal Government

Simulation Group

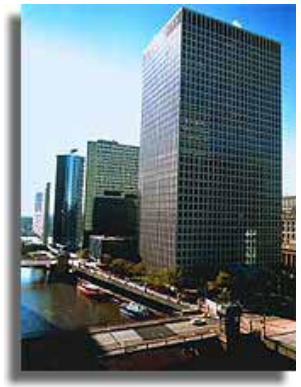
San Diego

512 Via De La Valle
Suite 310
Solana Beach, CA 92075

Nashville

500 Church Street
Suite 480
Nashville, TN 37219

Chicago



222 South Riverside Plaza
Suite 2320
Chicago, IL 60606

Simulation Tools We Use

AnyLogic, Arena, AutoMod, Coresim, Enterprise Dynamics, Extend, FlexSim, iGrafx Process, MedModel, ProModel, Quest, Railsim, RTC, Simflex, Simple++, Simul8, Vissim

Contact Information

Rainer Dronzek
Assistant Vice President

TranSystems
222 South Riverside Plaza, Suite 2320
Chicago, IL 60606

Phone: (312) 669-9601 x31401

Email: rwdronzek@transytems.com

Web: www.transystems.com

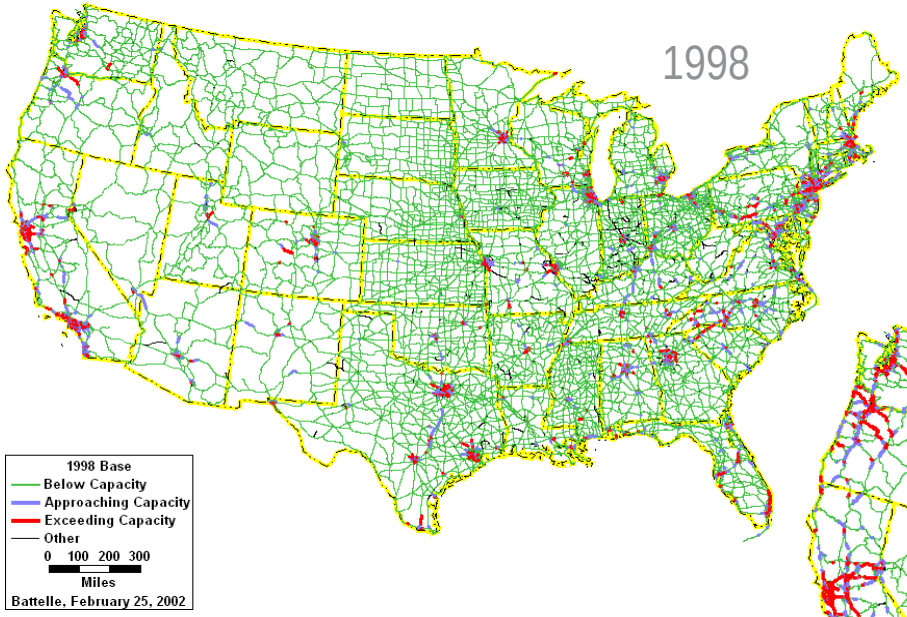
Crisis?

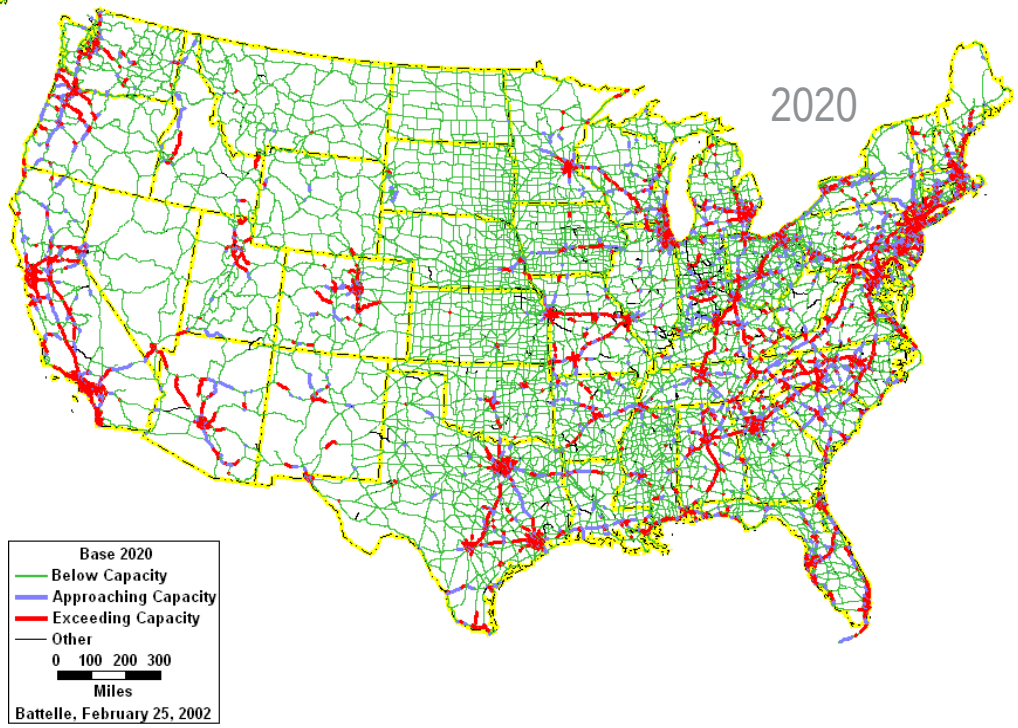
- 25% of GDP related to trade. Predicted to grow to 35% in 20 years
- Freight volume moved by all modes of transportation will nearly double by 2020 (from 15 to 25.5 billion tons)
- Many of highways, railroads, and intermodal facilities are running out of capacity to accommodate anticipated volumes of freight
- From 1980 to 2002, truck travel on US highways grew by 90% while lane-miles of public roads grew by only 5%
- Rail traffic is at or near segment capacity in intermodal corridors
- Between 1998 and 2020, the value of US freight (all modes) is expected to increase from $9 trillion to $30 trillion
- Between 1998 and 2020, the percentage of urban interstates carrying 10,000 or more trucks will increase from 27% to 69%

Source: Federal Highway Administration, U.S. Department of Transportation

Crisis?

Highway Congestion





Source: Federal Highway Administration, U.S. Department of Transportation

Model Demonstration

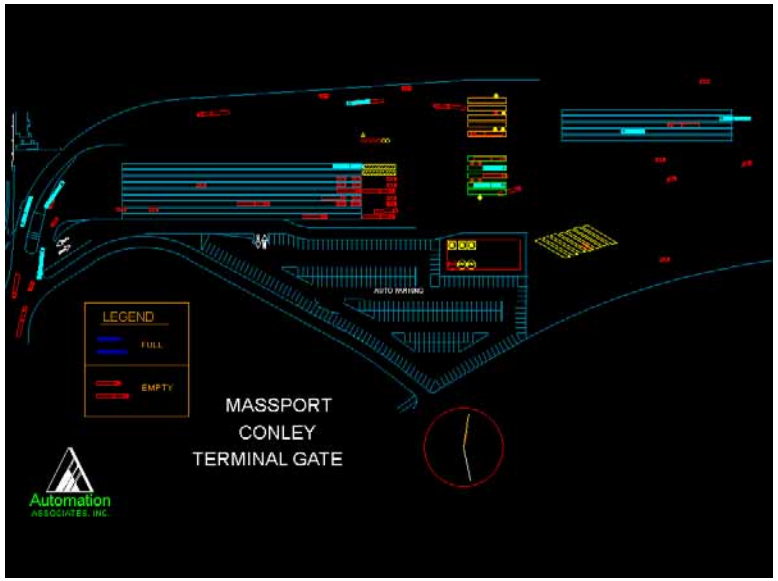
- Roadway & rail application
- Center for Commercial Deployment of Transportation Technologies (CDOTT)
- Victorville, CA
- Objectives
  - Model Maglev movement of containers
  - Reduce traffic congestion and emissions
- Arena 2-D model

What is Simulation Modeling?

- Creating a computerized model of a system that takes into account changes over time and process variation
- To create a model you define
  - Entities
  - Resources
  - Attributes and control logic
  - Statistics
- It can be applied during
  - Requirements definition
  - Conceptual & detailed design
  - Operations
  - Sales and marketing
  - Training

Model Demonstration

- Gate traffic application
- MassPort Conley Gate
- Objectives
  - Analyze capacity
  - Optimize traffic flow
  - Operations planning model
- 2-D simulation model
- Arena simulation software

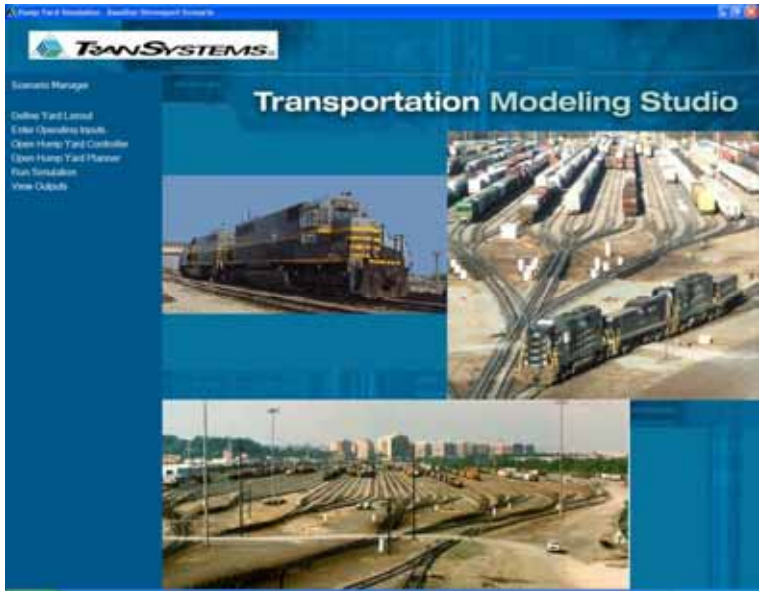


Characteristics of a Simulation Model

- Takes into account random (stochastic) behavior
- Models each entity moving through a system
- Handles complex interactions
- Not all system details are modeled
- Abstracts the system to an appropriate level
- Compresses time
- Animates the system explicitly, conceptually or not at all

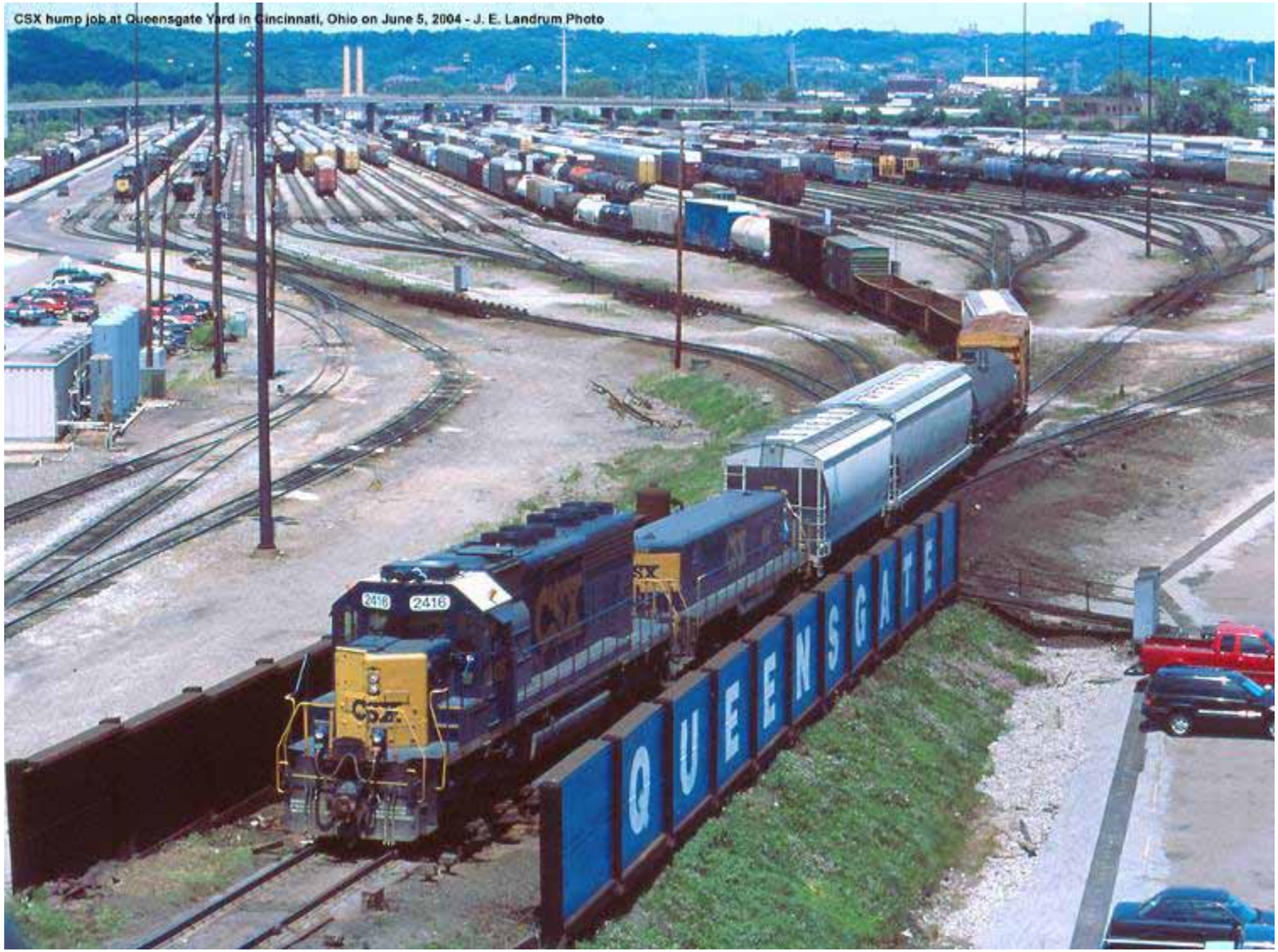
Model Demonstration

- Humpyard application
- Objectives
  - Analyze infrastructure and operating rule changes
  - Capture tribal knowledge
- 2-D simulation model
- Arena simulation software
- TranSystems Modeling Studio



Hump Yards

Hump Yards


CSX hump job at Queensgate Yard in Cincinnati, Ohio on June 5, 2004 - J. E. Landrum Photo
2418
QUEENSGATE

Hump Yards

Model Demonstration

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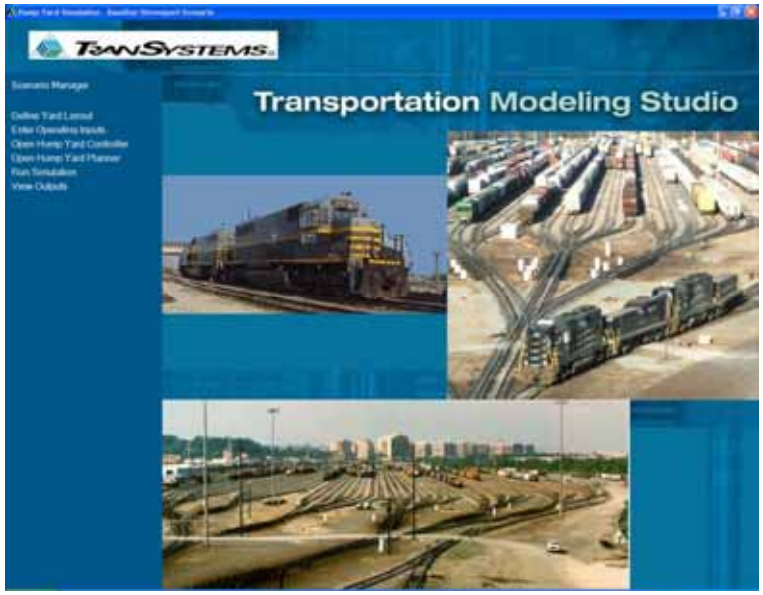
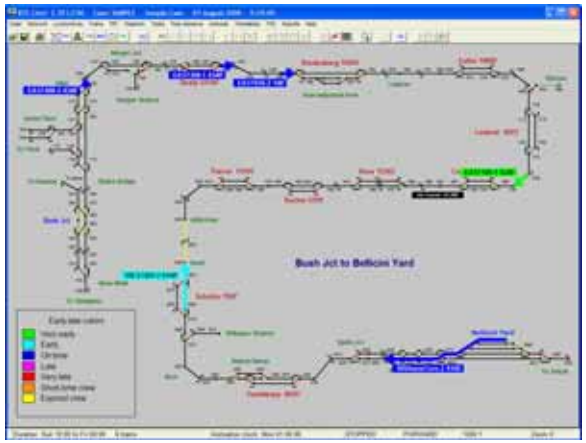


Why Simulate?

- Experiment without mock-ups
- Avoid disturbing systems & people
- Visualize under variety of conditions
- Understand complex interactions
- Provide an “insurance policy”

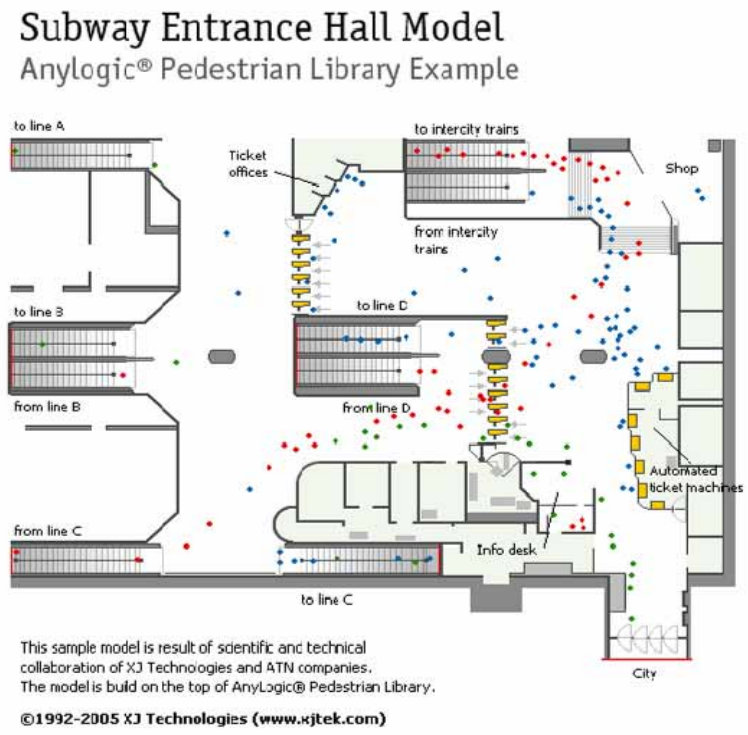
Model Demonstration



- Rail Traffic Controller™ (RTC)
- Used to analyze dispatch & scheduling logic
- Network inputs
  - Track layout
  - Signals
  - Yards and Stations
- Rolling Stock
  - Car dimensions, weights, axle counts
  - Locomotive tractive effort and dynamic brake forces
  - Air brake forces for both cars and locomotives
- Trains
  - Locomotive consists by type, number and position in train
  - Trailing consists: loads, empties, tons, feet, special instructions
  - Routes and stopping patterns: event locations, minimum dwell
  - Pick ups and set outs of blocks with corresponding consists
  - Requested schedules: departure, arrival, protected times

Model Demonstration

- Pedestrian application
- Agent based model
- Objectives
  - Model flow and queues
  - Identify bottlenecks
  - Analyze schedules and their impact on flow
- 2-D simulation model
- AnyLogic simulation software
- AnyLogic Pedestrian Library

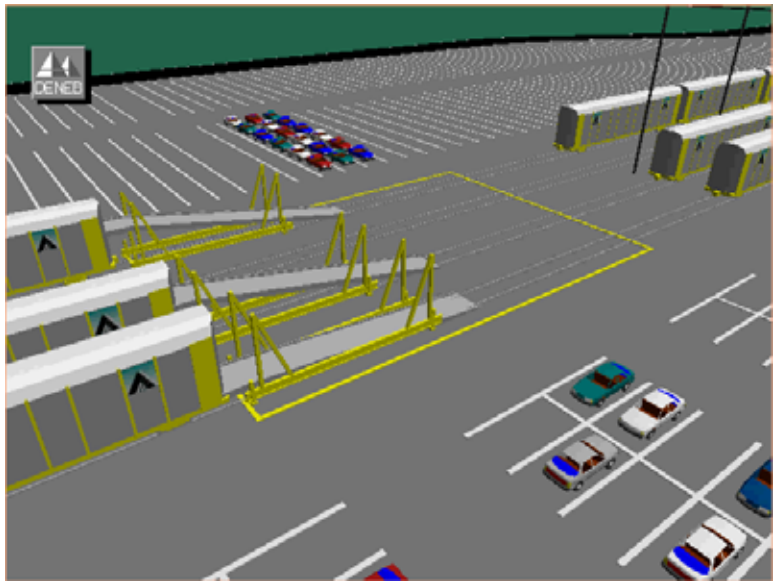


Visualization Demonstration

- Port of Ft. Lauderdale
- Objectives
  - Provide visualization of terminal and transit facilities
- 3-D animation
- 3D Studio and others

Model Demonstration

- Auto terminal application
- Train loading & unloading model
- Objectives
  - Validate capacity requirements for parking areas
  - Determine total loading and unloading times
  - Marketing
- 3-D simulation model
- AutoMod simulation software



Model Demonstration

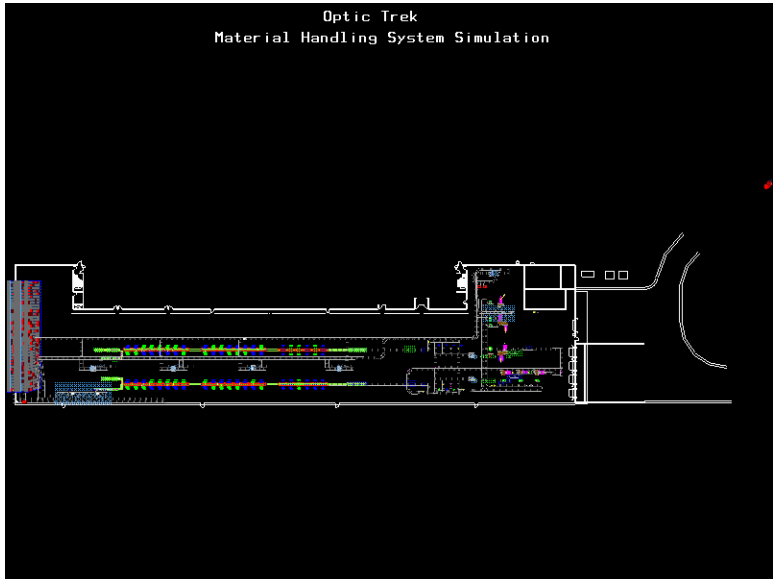
- Rail wheel finishing
- Genesys & Griffin Wheel Company
- Objectives
  - Validate proposed system design
  - Marketing
- Results
  - Station utilization max - 85%
  - Avg rate – 45.7 secs/wheel
  - Avg time in system - 41.0 min
    - Move - 3.9 min
    - Blocked/waiting - 29.2 min
    - Operations - 7.8 min
- 2-D simulation model
- ProModel simulation software

Model Demonstration

- Traffic application
- Central Park Ave, Yonkers, NY
- Intersection, traffic analysis
- Objectives
  - Identify bottlenecks in the corridor
  - Visualize the traffic conditions
  - Demo for proposal
- 3-D simulation model
- Integrated satellite imagery
- VisSim simulation software

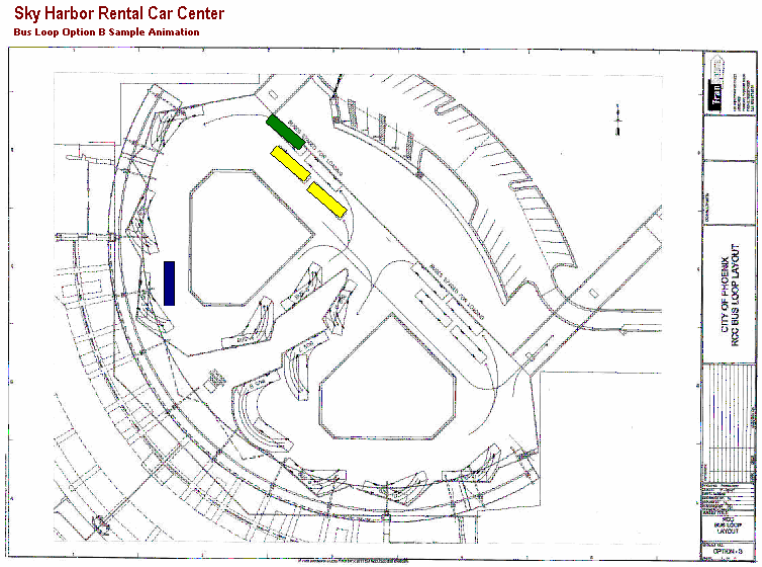
Model Demonstration

- Automated distribution center
- New facility, including automated storage & retrieval system
- Objectives
  - Validate capacity & capability
  - Marketing & training
  - Future analyses
- 3-D simulation model
- AutoMod simulation software

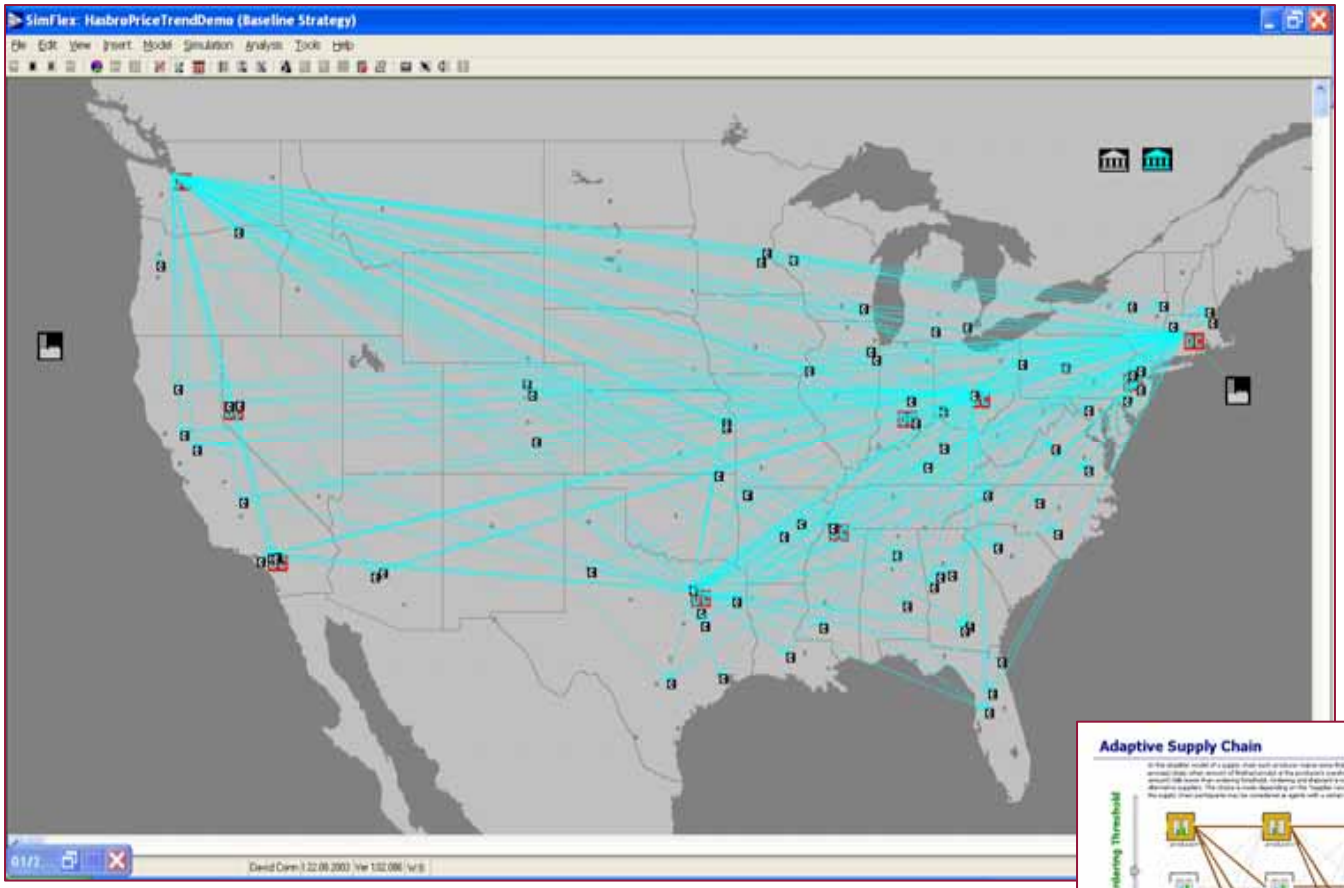


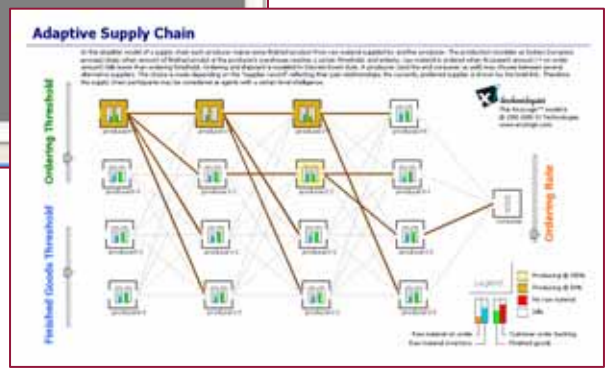
Model Demonstration

- Airport rental car operations application
- Objectives
  - Compare several layout concepts
  - Quantify wait times and queue lengths
- 2-D simulation model
- Arena simulation software



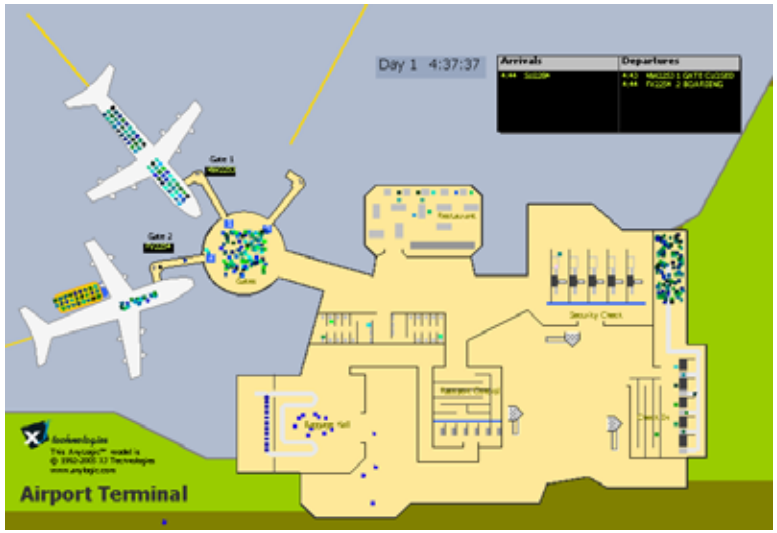
Modeling the Entire Supply Chain





Model Demonstration

- Airport pedestrian flow application
- Objectives
  - Quantify corridor and security screening capacity
  - Identify bottlenecks
  - View system in terms of flight schedules
  - Determine restaurant capacity
  - Predict bus and other mass transit requirements
- 2-D simulation model
- AnyLogic simulation software



Model Demonstration

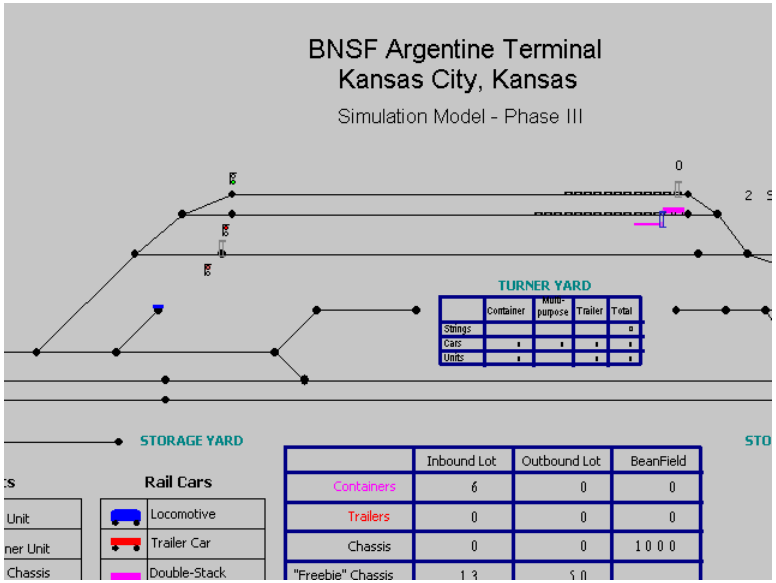
- Commercial distribution application
- Swagelok
  - New manufacturing facility, includes carousel-based distribution system
  - Objectives
    - Validate # of buffer lanes
    - Training & marketing
    - Future analyses
  - 3-D simulation model
  - AutoMod simulation software
  - TranSystems Modeling Studio

Model Demonstration

- Transit infrastructure
- New York Cross Harbor Study
- Objectives
  - Assess feasibility of cross harbor tunnel
  - Determine environmental impact of new system
  - Create animation to effectively present findings to various constituent groups
- 2-D simulation model
- Arena simulation software
- Transportation Modeling Studio

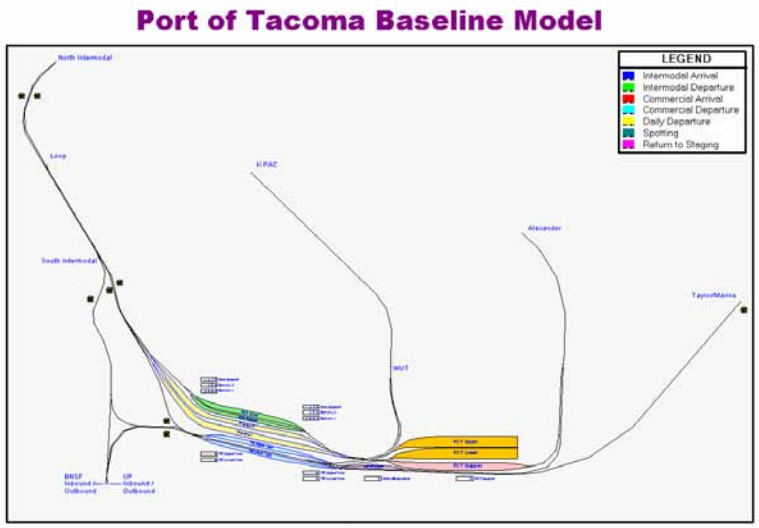
Model Demonstration

- Intermodal rail terminal application
- BNSF - Kansas City
- Objectives
  - Add/modify infrastructure to meet future demands?
  - Determine & quantify terminal capacity problems
  - Operations planning model for periodic capital justification analysis
- 2-D simulation model
- Arena simulation software



Model Demonstration

- Intermodal rail terminal application
- Port of Tacoma
- Objectives
  - Add/modify infrastructure to meet future demands?
  - Determine & quantify capacity problems
  - Operations planning model
- 2-D simulation model
- Arena simulation software



Automation Associates, Inc.

Questions & Answers